

IN THE CLAIMS

The pending claims are reproduced herein for the Examiner's convenience.

1. (Previously Presented) An apparatus comprising:
 - a substrate; and
 - a plurality of micropins thermally coupled to the substrate, the plurality of micropins arranged in a pixel like pattern over the substrate, the micropins positioned to cause a fluid passing through the plurality of micropins to travel a nonstraight path.
2. (Original) The apparatus of claim 1, wherein the plurality of micropins comprises a plurality of micropins formed from the substrate.
3. (Original) The apparatus of claim 1, wherein the substrate comprises an integrated circuit (IC) die.
4. (Original) The apparatus of claim 1, wherein the plurality of micropins comprises a plurality of micropins coupled to an interface layer, the interface layer thermally coupled to the substrate.
5. (Original) The apparatus of claim 4, wherein the interface layer comprises a diamond film.
6. (Original) The apparatus of claim 4, wherein the interface layer comprises a solderable layer.
7. (Original) The apparatus of claim 6, wherein the solderable layer comprises a solderable layer formed from at least one of copper (Cu), gold (Au), nickel (Ni), aluminum (Al), titanium (Ti), tantalum (Ta), silver (Ag), and Platinum (Pt).
8. (Original) The apparatus of claim 1, wherein the plurality of micropins comprises a plurality of micropins substantially enclosed in a device, the device having a cover disposed over the plurality of micropins.

9. (Original) The apparatus of claim 8, wherein the device further comprises an inlet and an outlet.

10. (Original) The apparatus of claim 9 further comprising a pump, the pump having an outlet, the outlet material transferably coupled to the inlet of the device.

11. (Original) The apparatus of claim 1, wherein the plurality of micropins comprises a plurality of micropins substantially enclosed in a device, the device includes a cover having the plurality of micropins formed thereon.

12. (Original) The apparatus of claim 11, wherein the device further comprises an inlet and an outlet.

13. (Original) The apparatus of claim 12 further comprising a pump, the pump having an outlet, the outlet material transferably coupled to the inlet of the device.

14. (Original) The apparatus of claim 1, wherein each of the plurality of micropins comprises a micropin having a primitive geometric shape.

15. (Original) The apparatus of claim 1, wherein each of the plurality of micropins comprises a micropin having a complex geometric shape.

16. (Original) The apparatus of claim 1, wherein the plurality of micropins comprises a plurality of micropins arranged to facilitate flow of material across the plurality of micropins in at least two directions.

17. (Original) A heat exchange system comprising:

 a device having an inlet and an outlet, comprising:

 a substrate, and

a plurality of micropins thermally coupled to the substrate, the plurality of micropins arranged to facilitate flow of material across the plurality of micropins in at least two directions, and arranged in a pixel like pattern over the substrate;

a pump, the pump having an inlet and an outlet, the outlet of the pump material transferably coupled to the inlet of the device; and

a heat exchanger, the heat exchanger having an inlet and an outlet, the inlet of the heat exchanger material transferably coupled to the outlet of the device, and the outlet of the heat exchanger material transferably coupled to the inlet of the pump.

18. (Original) The heat exchange system of claim 17, wherein the plurality of micropins comprises a plurality of micropins formed from the substrate.

19. (Original) The heat exchange system of claim 17 further comprising an integrated circuit (IC) die thermally coupled to the plurality of micropins.

20. (Original) The heat exchange system of claim 17, wherein the device comprises a device substantially enclosing the plurality of micropins, the device having a cover disposed over the plurality of micropins.

21. (Original) The heat exchange system of claim 17, wherein the device comprises a device substantially enclosing the plurality of micropins, the device including a cover having the plurality of micropins formed thereon.

22. (Previously Presented) An electronic system comprising:

a substrate, the substrate thermally coupled to an integrated circuit (IC) die;

a plurality of micropins thermally coupled to the substrate, the plurality of micropins arranged in a pixel like pattern over the substrate, the micropins positioned to cause a fluid passing through the plurality of micropins to travel a nonstraight path;

a wiring board electrically coupled to the IC die; and

a memory device electrically coupled to the wiring board.

23. (Original) The electronic system of claim 22, wherein the plurality of micropins comprises a plurality of micropins formed from the substrate.
24. (Original) The electronic system of claim 22, wherein the plurality of micropins comprise a plurality of micropins substantially enclosed in a device, the device having a cover disposed over the plurality of micropins.
25. (Original) The electronic system of claim 24, wherein the device further comprises an inlet and an outlet.
26. (Original) The electronic system of claim 25 further comprising a pump, the pump having an outlet, the outlet coupled to the inlet of the device.
27. (Original) The electronic system of claim 22, wherein the plurality of micropins comprises a plurality of micropins substantially enclosed in a device, the device includes a cover having the plurality of micropins formed thereon.
28. (Original) The electronic system of claim 27, wherein the device further comprises an inlet and an outlet.
29. (Original) The electronic system of claim 28 further comprising a pump, the pump having an outlet, the outlet material transferably coupled to the inlet of the device.
30. (Original) The electronic system of claim 22, wherein the memory device comprises a flash memory device.
31. (Previously Presented) An electronic system comprising:
a substrate, the substrate thermally coupled to an integrated circuit (IC) die;

a plurality of micropins thermally coupled to the substrate, the plurality of micropins arranged to facilitate flow of material in a nonstraight path across the plurality of micropins in a pixel like pattern over the substrate, and substantially enclosed in a device, the device having an inlet and an outlet;

a pump, the pump having an inlet and an outlet, the outlet of the pump material transferably coupled to the inlet of the device;

a heat exchanger, the heat exchanger having an inlet and an outlet, the inlet of the heat exchanger material transferably coupled to the outlet of the device, and the outlet of the heat exchanger material transferably coupled to the inlet of the pump;

a wiring board electrically coupled to the substrate; and

a memory device electrically coupled to the wiring board.

32. (Previously Presented) The electronic system of claim 31, wherein the plurality of micropins comprises a plurality of micropins formed from the substrate.

33. (Previously Presented) The electronic system of claim 31, wherein the device comprises a device having a cover disposed over the plurality of micropins.

34. (Previously Presented) The electronic system of claim 31, wherein the device comprises a device having a cover, the cover having the plurality of micropins formed thereon

35. (Previously Presented) The electronic system of claim 31, wherein the memory device comprises a flash memory device.

36. (Previously Presented) The apparatus of claim 1, wherein the plurality of micropins are nonsymmetrical in shape.

37. (Previously Presented) The apparatus of claim 1, further comprising a cover for the substrate, the cover including a plurality of micropins.

38. (Previously Presented) The apparatus of claim 1, wherein the plurality of micropins are positioned to cause a fluid passing through the plurality of micropins to travel a tortuous path.

39. (Previously Presented) The apparatus of claim 1, wherein the plurality of micropins are positioned to cause a fluid passing through the plurality of micropins to travel a nonstraight path. the micropins having nonuniform dimensions

40. (Previously Presented) An apparatus comprising:

a substrate having sidewalls; and

a cover disposed over the sidewalls of the substrate, the cover including a plurality of micropins coupled to the cover, wherein the micropins are thermally coupled to the substrate when the cover is disposed over the sidewalls of the substrate.

41. (Previously Presented) The apparatus of claim 40, wherein the plurality of micropins are positioned to cause a fluid passing through the plurality of micropins to travel a tortuous path.

42. (Previously Presented) The apparatus of claim 40, wherein the plurality of micropins are arranged in a pixel like pattern over the cover.